NASA TECH BRIEF

Marshall Space Flight Center

Gravitational Gradiometer Measures Mass Changes

An instrument has been designed and developed through a program of research, demonstrating the feasibility of measuring mass distributions of the earth, moon, and other celestial bodies by detecting the spatial gradients of their fields from orbiting vehicles. The device is a differential angular accelerometer whose structure consists of a system of spring-coupled rotating masses held in a special geometric configuration. Studies have shown that the instrument will have significant scientific engineering value in earth geodesy programs, in the investigation of the asteroid belt and outer planets and their satellites. It may be of particular importance in mineralogical surveying applications because of its portability, accuracy, and rugged construction.

In the basic concept of the rotating gravitational gradient sensor, if a system of proof masses is rotated in the static gravitational field of an object, the gravitational force gradient of this field will induce dynamic forces on the proof masses with a frequency which is twice the rotation frequency of the system. Inertial effects caused by accelerations of the proof mass mounting structure will induce forces with a frequency equal to the rotational frequency. The strength and direction of the gravitational force gradient can be determined independently of the inertial forces by measuring the amplitude and phase of the vibration induced in these proof masses at the double frequency. In effect, the proof mass system used is a system masses coupled together with springs, in a configuration which becomes a rotating differential angular accelerometer. Mechanical motion is converted into an electrical signal through the use of a piezoelectric strain transducer.

Note:

1. Information concerning this innovation may be of interest to the designers, manufacturers and users of surveying equipment.
2. Requests for further information may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Code A & TS-TU
   Huntsville, Alabama 35812
   Reference: B72-10140

Patent Status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: C. C. Bell of
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